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PROJECT: German Research Satellite (GRS-A)

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NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (202) 962-4155
WASHINGTON, D.C. 20546 TELS: (202) 963-6925

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GERMAN SATELLITE LAUNCH

The first satellite in a cooperative space program between the Federal Republic of Germany and the United States is scheduled to be launched into a near polar orbit no earlier than November 6, 1969, from the Western Test Range, California. The launch vehicle will be a four-stage, solid-fuel Scout rocket.

Called GRS-A (for German Research Satellite), the 157-pound, German-built satellite will carry seven scientific experiments designed to study the earth radiation belt, the aurorae, and solar particle events. Special emphasis is placed on measuring the intensity and distribution of protons and electrons in terms of time and location. In orbit the satellite will be called AZUR.

The launching of GRS-A is a major milestone marking the second phase of a two-phase cooperative program between the German Ministry for Scientific Research (Bundesministerium fuer wissenschaftliche Forschung)-BMwF) and the National Aeronautics and Space Administration (NASA).

The first phase consisted of a series of sounding rocket launchings--from sites in Canada, Sweden and Brazil--designed to checkout GRS-A instrumentation. These activities were conducted during 1966 and 1967.

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The formal agreement for the program was signed in July 1965 by representatives of BMwF and NASA. Under it the BMwF is generally responsible for providing spacecraft hardware and experiments, while NASA provides launch vehicles, technical consultation, training, and tracking and data acquisition support. Close coordination between the two organizations exists on matters relating to all phases of the program--design, final construction, test, and satellite/launch vehicle compatibility.

The orbit planned for GRS-A will have an apogee of about 2,000 statute miles and a perigee of about 240 statute miles inclined 102 degrees to the equator. It will take about two hours and two minutes for the satellite to complete one orbit. Its planned operational lifetime is one year.

The spacecraft is stabilized at injection by spinning up the fourth stage to about 178 rpm. After separation the spin rate is reduced to about zero rpm by a two-stage yo-yo despin system. An internal grid of eight hysteresis damping rods provides further damping of satellite oscillations so that after approximately 10 days in orbit the spacecraft will automatically align itself and become stabilized along the lines of force of the Earth's magnetic field. This alignment is accomplished by means of in-board permanent magnets.

The seven scientific experiments carried by GRS-A are provided by five different German research institutes.

In general the experiment objectives continue studies conducted by earlier NASA Explorer-series satellites as well as the Orbiting Geophysical Observatories launched by NASA into near polar orbits.

The satellite will be tracked and interrogated by a system of stations operated under direction of BMwF augmented by NASA's world-wide Space Tracking and Data Acquisition Network (STADAN). BMwF will be responsible for data reduction, analysis, and publication of experiment results.

Data will be made available exclusively to the German principal investigations for a period of one year, during which they will exercise their rights of first publication.

After this one-year period data records will be deposited with the NASA Space Science Data Center operated by the Goddard Space Flight Center, Greenbelt, Maryland, and will be made generally available to any interested scientist.

The Office of Space Science & Applications, NASA Headquarters, Washington, D. C., has program responsibility for the NASA portion of this cooperative effort, which is coordinated through the NASA Headquarters Office of International Affairs.

The NASA Goddard Space Flight Center is charged with management of the project for NASA. The NASA Langley Research Center is responsible for providing the launch vehicle and launch services. The U. S. Air Force 6595th Air Test Wing provides the Western Test Range launch team. NASA's Kennedy Space Center Unmanned Launch Operations provides launch operations support at WTR. The Scout launch vehicle is built by Ling-Temco-Vought, Inc., Dallas, Texas.

The German project management responsibility is assigned by BMwF to the Gesellschaft fuer Weltraumforschung (GfW) Space Research Corporation, Bonn, Germany.

The design, manufacture, integration, and testing of the spacecraft was accomplished by seven German aerospace and electronic companies coordinated by Messerschmitt-Boelkow-Blohm, Corporation, Munich, Germany.

LAUNCH VEHICLE

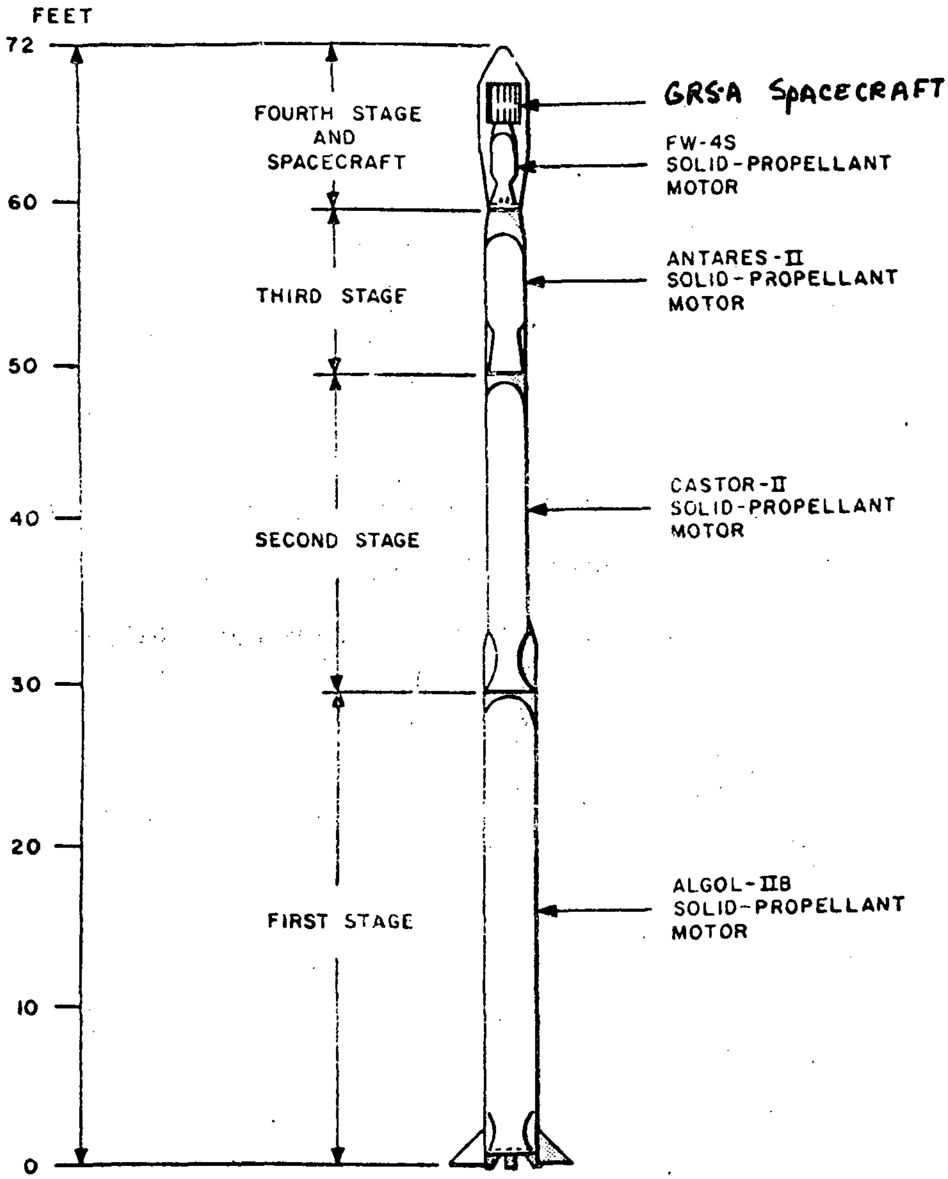
The Scout program is managed by NASA's Langley Research Center, Hampton, Va.

Scout is a four-stage solid propellant launch vehicle. The four Scout motors, Algol, Castor, Antares, and FW-4S are interlocked with transition sections that contain guidance, control, ignition, instrumentation system, separation mechanics, and the spin motors needed to stabilize the fourth stage.

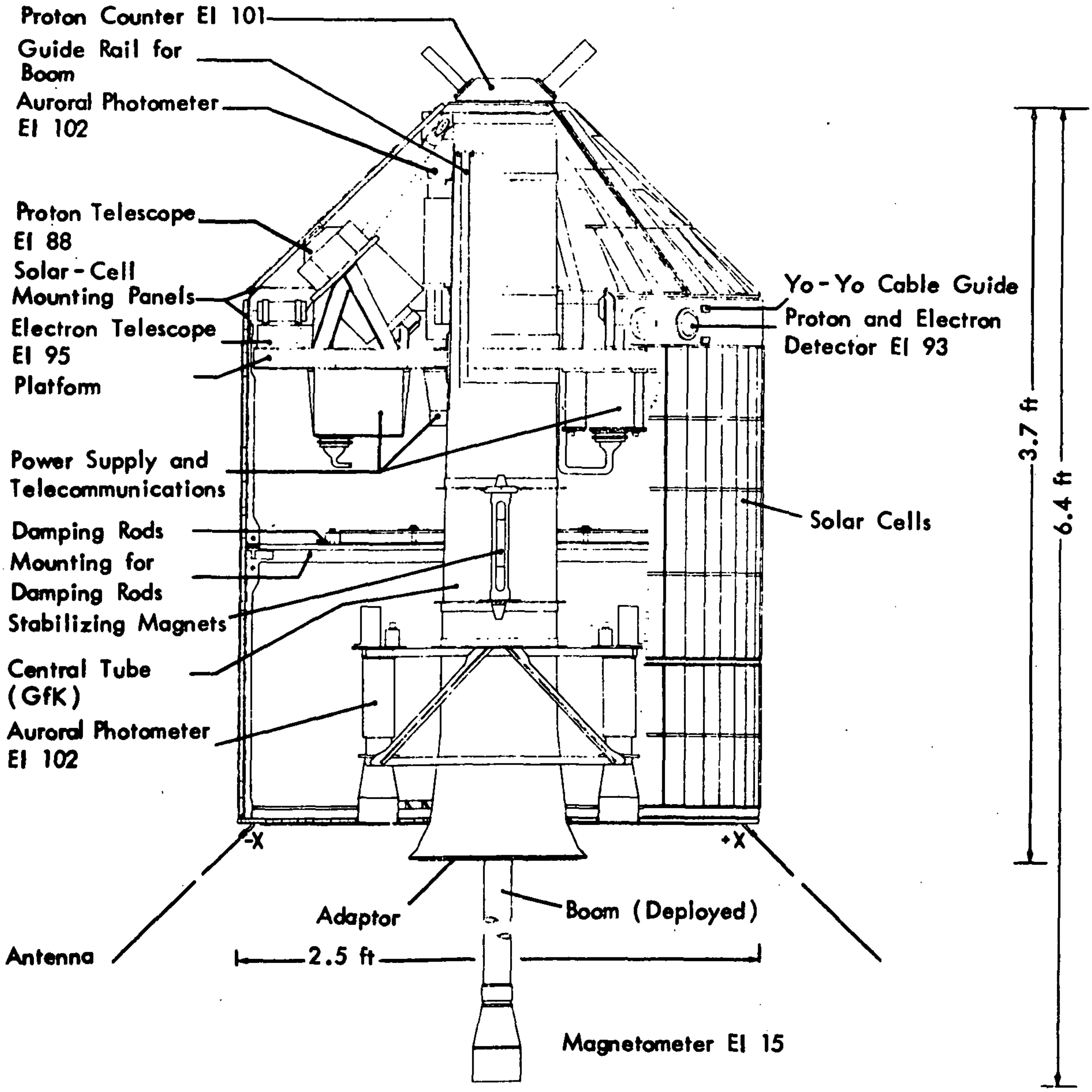
Guidance for Scout is provided by an autopilot and control achieved by a combination of aerodynamic surfaces, jet vanes and hydrogen peroxide jets. The launch vehicle is approximately 73 feet long and weighs about 40,000 pounds at liftoff. Scout vehicle number S-169 and the GRS-A spacecraft will be set on an initial launch azimuth of 197.211° to obtain a retrograde orbit.

Flight Sequence

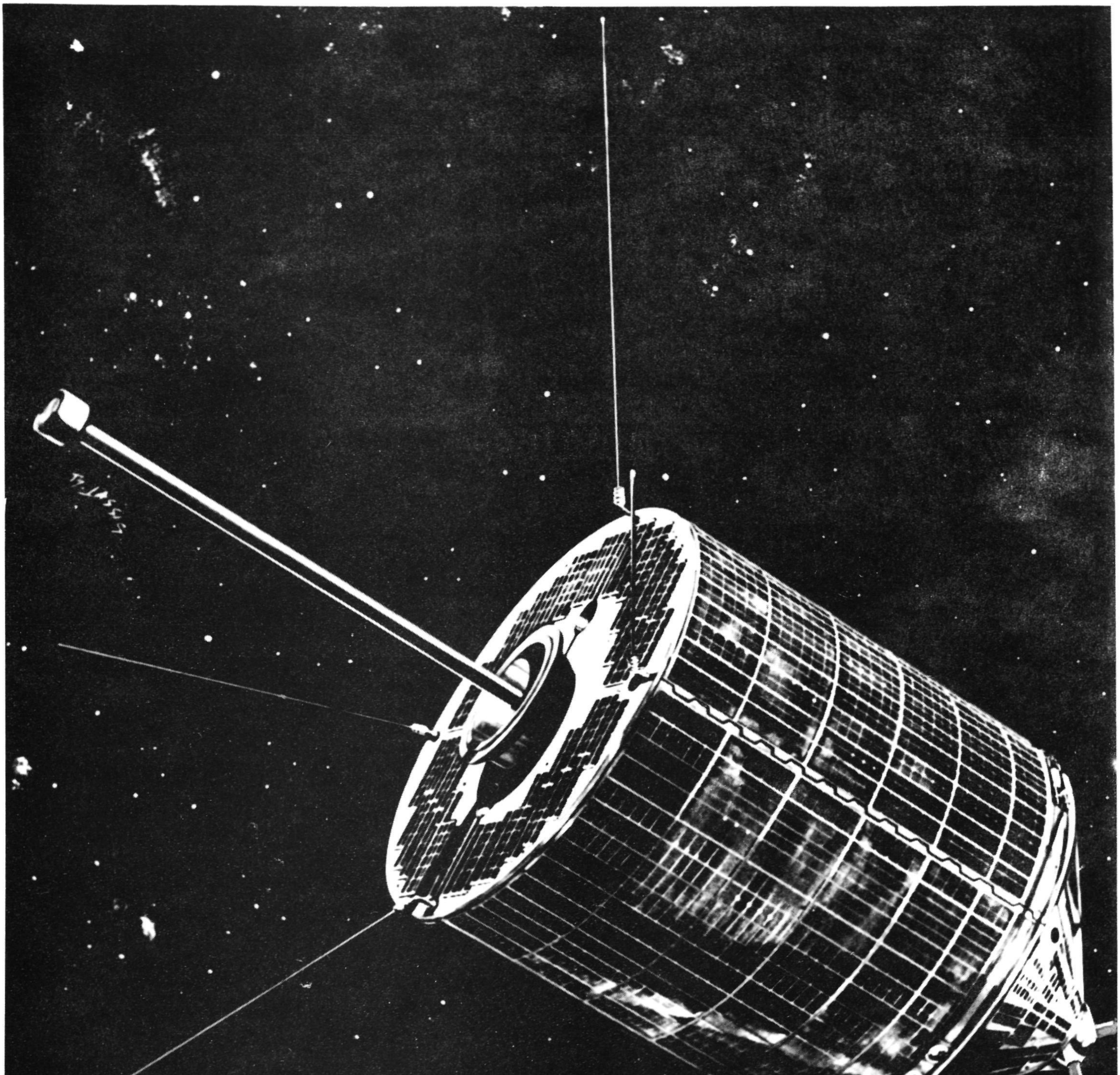
Event	Time (seconds)
Liftoff	-
First stage burnout	76.57
Second stage ignition	83.63
Second stage burnout	123.06
Heatshield ejection	147.00
Third stage ignition	148.70
Third stage burnout	184.60
Spin-up	472.96
Third stage separation	474.46
Fourth stage ignition	478.96
Fourth stage burnout & orbital injection	513.66



Scout Launch Vehicle



German Research Satellite A



GRS-A/AZUR FACT SHEET

Launch Window:	20-minute window which changes only slightly from day-to-day. Window opens at 5:51 PM (PST), November 6, 1969.	
Launch Site:	Western Test Range, Lompoc, California, Pad SLC-5	
Launch Rocket:	Four-stage solid fuel Scout	
Orbit:	Apogee:	About 3,200 km (2,000 statute miles)
	Perigee:	About 390 km (240 statute miles)
	Period:	122 minutes
	Inclination:	102 degrees
Spacecraft:	Weight:	157 pounds with about 37 pounds of experiments.
	Structure:	Cylinder 30 inches in diameter with overall length of 48 inches. Conical shaped top; flat bottom from which protrude four antennas and a 33-inch-long magnetometer boom.
	Power:	Practically entire exterior portion of spacecraft is covered with solar cells to charge silver-cadmium

GRS-A/AZUR FACT SHEET (CONT'D.)

Power: (cont'd) battery pack. Power needed to operate GRS-A ranges from 17 watts up to 29 watts during peak operating period.

Telemetry: Two PCM/PM transmitters operating at 136.74 MHz and 136.56 MHz, respectively.

Tracking and Data Acquisition: Tracking, scientific and spacecraft performance data will be acquired from the GRS-A by the following stations:

* The Central German Ground Station, Lichtenau, Federal Republic of Germany, which will relay real-time and taped data and commands between spacecraft and the German Control Center at Oberpfaffenhofen, near Munich.
* Stations of ESTRAC operated by the European Space Research Organization (ESRO) located in Ny Alesund, Spitsbergen; Fairbanks, Alaska; Redu, Belgium; and Port Stanley, Falkland Islands.

GRS-A/AZUR FACT SHEET (CONT'D.)

Tracking and Data Acquisition:(cont'd.)

* Special stations under contract to Gesellschaft fuer Weltraumforschung, mbH (Space Research Corporation) at Kevo, Finland; Churchill Research Range, Canada; and Reykjavik, Iceland.

DESCRIPTION OF EXPERIMENTS

EI 15 MAGNETOMETER

A two component flux gate magnetometer mounted on an extendable boom will be used. The two components are oriented normal to each other and normal to the magnetic axis of the satellite. The analog outputs of the two flux gates will be digitized using a 12-bit analog digital converter. The 12-bit information will be included twice in the main data frame which has a ten second duration, while the last 6 bits will be transmitted in real time every 100 milliseconds in order to measure small amplitude transient disturbances of the geomagnetic field.

EI 88 PROTON-ALPHA TELESCOPE

This unit uses seven semiconductor surface barrier detectors mounted one behind the other. Particles entering the 28 degree cone of acceptance will be detected using a three-fold coincidental/anti-coincidental scheme according to their energy in seven different channels. A scintillation counter surrounds the detector stack and gives veto signals if particles from unwanted directions enter the device. Two sets of this telescope will be used on the satellite. The one is oriented under an angle of 90 degrees relative to the magnetic axis, the other under an angle of 135 degrees. A magnet in the entrance aperture will sweep off electrons which otherwise might disturb the proton measurements.

DESCRIPTION OF EXPERIMENTS (CONT'D)

EI 92 LOW ENERGY PROTON TELESCOPE

Two surface barrier semiconductor detectors mounted one behind the other serve for low energy proton detection. Particles entering the back detector will not be counted by using the signal from this one as a veto. Directional properties are achieved by using a solid aperture. A magnet in the aperture will prevent electrons from reaching the first detector. Information will be obtained by counting into six different energy channels.

EI 93 PROTON-ELECTRON DETECTOR

Two different units are used of the same build up. A lithium diffused cubic semiconductor detector is installed in each unit and is covered by a semispherically-shaped absorber, which has different wall thicknesses in the two units. Two-level pulse height discrimination is done on each of both units thus allowing the measurement of protons and electrons in two energy ranges. The units accept particles from a hemisphere and are therefore mounted to the spacecraft's skin such that the spacecraft will not shadow the two units.

EI 95 ELECTRON DETECTOR

This unit uses three Geiger Mueller Counters which have a very thin mica windows so that 40 keV electrons may be detected. They are oriented such that one looks normal to the magnetic axis of the satellite while the other two look

DESCRIPTION OF EXPERIMENTS (CONT'D)

parallel and anti-parallel relative to the magnetic moment vector of the satellite. A fourth detector is shielded in order to get background information. One data channel per detector is used. Information is transmitted twice in each 10-second data frame, and in addition in real time with about a 12 millisecond time resolution.

EI 101 PROTON MONITOR

Two Geiger Mueller Counters with range cross sections are placed on top of the satellite. The two counters are shielded by different masses, so they respond to charged particles with energy above two different energy thresholds.

EI 102 PHOTOMETER

A photomultiplier watching the optical intensity behind an interference filter is used, its output current being digitized by a neon glow tube circuit. Three such units will be used, two looking toward the earth, over the northern hemisphere, the third one away from the earth as a background reference. The 3914 A^{o} and 2972 A^{o} auroral optical emission lines will be observed. Data will be transmitted in real time only. Measurements will be performed during shadow times only.

GRS-A/AZUR PROGRAM PARTICIPANTS

FEDERAL REPUBLIC OF GERMANY

Ministry for Scientific Research (BMwF)

Mr. Max Mayer	Head, Department of Space and Aeronautics Research
Mr. Bernhard Gaedke	Head, Subdepartment for Space Flight and Technology
Mr. Herbert Lindner	Head, Subdepartment for General Affairs and Space Science
Dr. Arthur Schendel	Head, Satellite Systems Section
Dr. Walther Regula	Head, Extraterrestrial Research Section
Mr. Manfred Otterbein	Azur Program Manager
Dr. Eckhard Luebbert	Azur Program Scientist

Space Research Corporation (GfW)

Mr. Walter Luksch	Technical Director
Mr. Ants Kutzer	Azur Project Manager
Mr. Dieter von Eckardstein	Azur Deputy Project Manager
Mr. Martin Schurer	Tracking & Data Acquisition Manager, German Satellite Control Center

Max. Planck Institute for Aeronomy

Dr. Erhard Keppler	Azur Project Scientist

GRS-A/Azur Experimenters

Dr. Gunter Musmann	Institut für Geophysik und Meteorologie der Technischen Hochschule, Braunschweig Magnetometer (El-15)
Dr. Dierk Hovestadt	Max-Planck-Institut für Extraterrestrische Physik, Garching b. München Proton Telescope (EI 88) and Proton Electron Detector (EI 93)
Mr. Jurgen Moritz	Institut für Reine-und-Angewandte-kernphysik der Universität Kiel, Kiel Proton Telescope (EI-92)

Dr. Lothar Rossberg	Max-Planck-Institut für Aeronomie, Institut für Stratosphärenphysik, Lindau/Harz Electron Counter (EI 95)
Dr. Erhard Kirsch	Max-Planck-Institut fur Aeronomie, Institut fur Stratosphärenphysik, Lindau/Harz Charged Particle Counter (EI 101)
Dr. Albin Rössbach	DFVLR - Institut für Physik der Atmosphäre, Oberpfaffenhofen/Obb Photometer (EI 102)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION-UNITED STATES

NASA Headquarters

Dr. John E. Naugle	Associate Administrator, Office of Space Science and Applications
Mr. Jesse Mitchell	Director, Physics and Astronomy Programs
Dr. Alois W. Schardt	Chief, Particles & Fields Program GRS-A Program Scientist
Mr. John R. Holtz	Explorers & Sounding Rockets Program Manager, NASA Headquarters
Mr. Raymond Miller	Explorers & Sounding Rockets Deputy Program Manager
Mr. Paul E. Goozh	Scout Program Manager

NASA Goddard Space Flight Center

Dr. John F. Clark	Director
Mr. Daniel G. Mazur	Director, Technology Division
Mr. Robert C. Baumann	Chief, Spacecraft Integration & Sounding Rocket Division
Mr. Allen L. Franta	GRS-A Project Manager
Dr. George F. Pieper	Director, Space Sciences GRS-A Project Scientist
Mr. Charles F. Rice, Jr.	GRS-A Project Coordinator
Mr. William F. Mack	GRS-A Tracking Manager

NASA Langley Research Center

Mr. Roland D. English	Head, Scout Project Office
Mr. Larry R. Tant	Scout Payload Coordinator
Mr. Clyde W. Winters	Scout Project Launch Director

Western Test Range - Launch Operations

Mr. William D. Hinshaw	Head, Langley Mission Support Office, Western Test Range
Mr. Henry R. Van Goey	Chief, Kennedy Space Center, Unmanned Launch Operations, Western Test Range
Mr. Canuto R. Fuentes	GRS-A Coordinator, Kennedy Space Center, Unmanned Launch Operations, Western Test Range

MEMORANDUM OF UNDERSTANDING
BETWEEN THE
GERMAN MINISTRY FOR SCIENTIFIC RESEARCH
AND THE UNITED STATES
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

1. The German Ministry for Scientific Research (Bundesministerium fur Wissenschaftliche Forschung (BMwF) and the United States National Aeronautics and Space Administration (NASA) affirm a mutual interest in cooperating in space research for peaceful scientific purposes by conducting, on a timely basis, a satellite project to investigate the earth's radiation belts. It is hoped that this project will mature in 1968 with the launching of a satellite carrying energetic particles experiments from the Western Test Range of the United States into an elliptical earth orbit.

2. The cooperative project is planned to consist of two consecutive phases, the second to proceed with mutual agreement that scientific and technical feasibility has been demonstrated in the first:

Phase I--Appropriate sounding rocket and balloon payloads will be launched, as mutually agreed, to test the functioning of proposed satellite instrumentation and to verify the performance of the proposed satellite experiments.

Phase II--A scientific satellite carrying experiments to perform an integrated study of the spectra and fluxes of energetic particles in the earth's inner radiation belts will be placed into an elliptical earth orbit by a Scout vehicle.

3. It is understood that this program is experimental in character and, therefore, subject to change, by mutual agreement, on the basis of the results of Phase I and other technical requirements.

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4. The BMwF shall, in general, assume responsibility for:

   a. Providing instrumentation for the agreed experiments for Phases I and II.

   b. Providing balloons and balloon launching support for experiments to be tested in balloon flights.

   c. Designing, fabricating, and testing of all payloads for sounding rocket balloon and satellite flights, including satellite structure and airborne telemetry, and delivering to the launch site two flight-qualified payloads or spacecraft for each flight mission.

   d. Supplying payload and spacecraft ground checkout and launch support equipment.

   e. Providing such tracking and data acquisition for Phase II as may be feasible with the use of projected ground stations in West Germany.

   f. Reducing and analyzing the data in all phases of the program.

5. NASA shall, in general, assume responsibility for:

   a. Providing a Javelin rocket and a Nike-Apache rocket, with back-ups, including appropriate nosecones, for Phase I.

   b. Providing a Scout booster, with backup, including heat shields and spacecraft tiedown and separation mechanisms, for Phase II.

   c. Launching of the sounding rockets in Phase I and of the satellite in Phase II.

   d. Making available such training of German personnel in BMwF areas of responsibility as may be required and feasible within the limitations of NASA operational requirements.

e. Providing relevant technical consultation and technical data as appropriate.

f. Providing technical assistance in spacecraft testing and reviewing of final acceptance tests of satellite flight and backup units. Final determination of the suitability of flight units for launching will be by joint BMwF/NASA decision.

g. Tracking and data acquisition, as mutually agreed, in Phases I and II of the program, using existing NASA sounding rocket and scientific satellite tracking and data-acquisition facilities.

6. No exchange of funds is contemplated between the two cooperating agencies. Each agency will bear the costs of discharging its respective responsibilities, including travel and subsistence of its own personnel and transportation charges on all equipment for which it is responsible.

7. Each agency agrees to designate a single Project Manager to be responsible for coordinating the agreed functions and responsibilities of each agency with the other in the implementation of this agreement. Together they will establish a Joint Working Group with appropriate membership. Details for implementation shall be resolved on a mutual basis within this working group.

8. The scheduling of the two phases of the program shall be as mutually agreed.

9. BMwF and NASA will use their best efforts to arrange for free customs clearance of equipment required in this project.

10. Data obtained from the experiments shall be provided to the BMwF principal investigators for their analysis and evaluation for a period of approximately 1 year. (However, during this period, NASA may, for its own use, obtain copies of tapes or reduced data records as soon as they become available, without prejudice to the principal investigators' interests in first publication.)

During this 1-year period, all requests for data shall be referred to the BMwF principal investigators. After this period, records or copies of reduced data will be deposited with the NASA Space Science Data Center and listed with the appropriate World Data Center. Such records will then be made available to interested scientists, upon reasonable request, by the World Data Center or other selected repository. Preliminary and final results of the experiments will be made available to the scientific community in general through publication in appropriate journals and other established channels.

11. Release of public information regarding the joint project may be made by each agency for its own portions of the project as desired and, insofar as the participation of the other is involved, after suitable coordination.

/s/ L. Cartellieri
For the Bundesministerium fur
Wissenschaftliche Forschung

/s/ Hugh L. Dryden
For the National Aeronautics
and Space Administration

July 17, 1965
Date

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